

REMARKS

Claims 1-3, 5, 7, 9 and 11-19 are all the claims presently pending in the application.

Independent claims 1, 3, 5, 7, and 9 have been amended to define more clearly and particularly the features of the claimed invention.

Claims 2, 4, 6, 8, and 10 have been canceled without prejudice or disclaimer.

New Claims 15-19 have been added to provide more varied protection for the present invention. No new matter has been added.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicants specifically state that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

With respect to the prior art rejections, claim 1 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. (U.S. Publication No. 2002/0181574) in view of Tomisato, et al. (U.S. Patent No. 6,862,316). Claim 2 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Tomisato, et al., and further in view of Schuchman, et al. (U.S. Patent No. 5,283,780). Claims 3 and 5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Tomisato, et al., and further in view of Kubo, et al. (U.S. Publication No. 2001/0006533). Claims 4 and 6 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Tomisato, et al., and further in view of Kubo, et al., and further in view of Schuchman, et al. (U.S. Patent No. 5,283,780). Claim 7 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Horng, et al. (U.S. Patent No. 6,839,379). Claim 8 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Tomisato, et al., further in view of Kubo, et al., and further in view

of Horng, et al. Claims 10 stands rejected under 35 U.S.C. §103(a) as being unpatentable over Aizawa, et al. in view of Tomisato, et al., further in view of Kubo, et al., and further in view of Horng, et al., and further in view of Schuchman, et al.

These rejections are respectfully traversed in the following discussion.

I. THE CLAIMED INVENTION

As illustrated, for example, in independent claim 1, an equalizer for equalizing a detection signal obtained by detecting a transmission signal at an oversampling rate, the transmission signal periodically including known symbol patterns made up of at least one symbol, includes symbol pattern synchronizing means for reproducing symbol timing by detecting the symbol patterns based on the detection signal, equalizing means for acquiring an equalized signal by multiplying signals extracted from the detection signal at predetermined intervals of n samples and weights, symbol pattern generating means for generating a reference signal equal to the symbol patterns, error calculating means for acquiring an equalization error by subtracting the equalized signal from the reference signal, and weight updating means for updating the weights based on the detection signal and the equalization error at the timing of the symbol patterns.

Independent claims 3, 5, 7, and 9 define somewhat similar devices (and methods), according to the present invention.

Thus, the claimed invention provides an equalizer and equalization method as well as a receiver and reception method with little deterioration of the error rate characteristic even when a low oversampling rate or a short, known symbol pattern is used in order to overcome the disadvantages of symbol synchronization and demodulation processing at a high oversampling rate, which is the problem of the QAM system (e.g., see specification at page 7, first full paragraph). With the exemplary arrangement, carrying out selection diversity makes

it possible to acquire excellent reception quality even in a fading propagation path environment and drastically reduce the amount of DSP signal processing (e.g., see specification at page 8, first full paragraph).

Thus, the present invention can effectively reduce an operation speed of an equalizer by, for example, combining PSI modulation (0005-0006) and MAM (0007).

Conventionally, it was necessary to use a high over sample rate for an equalized process. However, the present inventors recognized that, as long as a high over sample rate is adopted to the symbol synchronization, the operation speed can be reduced.

Applicants recognize that those skilled in the art may consider that the equalization accuracy to the propagation properties deteriorates by reducing the sample rate. However, Applicants have found that, by following quickly the variation of the propagation properties and following the properties more quickly by inserting one or more symbols and short symbol patterns at a short interval (for example, 16 symbols), the equalization accuracy to the propagation properties can be improved by reducing the sample rate. When the symbol patterns are received, it is necessary to reflect weights of the equalizer immediately and the present invention uses an algorithm having a quick response such as an LMS.

II. THE PRIOR ART REJECTIONS

The Examiner alleges that the combination of Aizawa and one or more of Tomisato, Schuchman, Kubo, and Horng discloses or suggests all of the features of the claimed invention.

Applicant respectfully submits, however, that there are features of the claimed invention which are not disclosed or suggested by Aizawa, Tomisato, Schuchman, Kubo, and Horng, either individually or in combination. Therefore, Applicant traverses this rejection.

Particularly, the Examiner relies on Aizawa as disclosing the claimed “equalizing means” and step of “equalizing”, as recited, for example, in independent claims 1, 3, 5, 7, and 9.

However, Applicants submit that the training section 102 of Aizawa, upon which the Examiner relies, does not operate equalization (i.e., does not perform equalization), as alleged by the Examiner.

Instead, the training section 102 of Aizawa only calculates a tap coefficient W1 to W4. Although the replica generating section 105 conducts equalization, replica generating section 105 equalizes symbol patterns to reproduce a reception signal which receives the propagation path properties, not the detection signal.

Therefore, replica generating section 105 of Aizawa does not equalize a detection signal, as alleged by the Examiner.

Further, the replica generating section 105 differs from the claimed “*equalizing means*” of the present invention, as disclosed by the specification of the present invention.

For example, the replica generating section 105 of Aizawa does not multiply signals extracted from the detection signal at predetermined intervals of n samples and weights.

Therefore, even assuming *arguendo* that the cited references could be combined in the manner alleged by the Examiner, the present invention could not be achieved even if the training section 102 and the replica generating section 105 were combined.

Furthermore, nothing in Aizawa discloses or suggests the claimed “oversampling”.

That is, the apparatus of Aizawa cannot adopt adaptive equalization to produce a replica by equalization at a rate more than the symbol rate, because Aizawa must estimate a sequence using one symbol unit.

On the other hand, Kubo discloses an adaptive equalization apparatus which conducts equalization after decimation (e.g., see paragraphs 0003 and 0004 and Figures 20 and 21).

However, as described above, Applicants submit that even assuming *arguendo* that Aizawa and Kubo could be combined, such a combination would be difficult to achieve, and the ordinarily skilled artisan would not have been motivated to make such a difficult combination.

In contrast, the present invention can effectively reduce an operation speed of an equalizer by, for example, combining PSI modulation (0005-0006) and MAM (0007).

Conventionally, it was necessary to use a high over sample rate for an equalized process. However, the present inventors recognized that, as long as a high over sample rate is adopted to the symbol synchronization, the operation speed can be reduced.

As mentioned above, Applicants recognize that those skilled in the art may consider that the equalization accuracy to the propagation properties deteriorates by reducing the sample rate. However, Applicants have found that, by following quickly the variation of the propagation properties and following the properties more quickly by inserting one or more symbols and short symbol patterns at a short interval (for example, 16 symbols), the equalization accuracy to the propagation properties can be improved by reducing the sample rate. When the symbol patterns are received, it is necessary to reflect weights of the equalizer immediately and the present invention uses an algorithm having a quick response such as an LMS.

For the foregoing reasons, Applicants submit that Aizawa, Tomisato, Schuchman, Kubo, and Horng, either individually or in combination, do not disclose or suggest all of the features of the claimed invention.

Therefore, the Examiner is requested to reconsider and withdraw this rejection and to permit claims 1-3, 5, 7, and 9 to pass to immediate allowance.

IV. NEW CLAIMS

New claims 15-19 have been added to define more clearly and particularly the features of the present invention.

Applicants submit that claims 15-19 are patentable over the cited references, either individually or in combination, for at least somewhat similar reasons as those set forth above.

V. FORMAL MATTERS

Drawing Objection

The Office Action objects to Figures 9A-9C and 10. Figures 9A-9C and 10 are amended herewith in accordance with the Examiner's suggestion. Therefore, the Examiner is requested to withdraw this objection to the drawings.

Priority under 35 U.S.C. § 119

Applicants respectfully request that the Examiner check Box 12(a)(1) of the Office Action Summary indicating that the certified copies of the priority document have been received.

IDS Form PTO 1449

Applicants thank the Examiner for indicating that the reference cited in the Information Disclosure Statement filed on February 2, 2004 has been considered, and also that the references cited in the first form PTO 1449 of the IDS filed on May 6, 2002 have been considered.

However, it is noted that, for some reason, the Examiner has not provided an initialed and signed copy of the second form PTO 1449 for the IDS filed on May 6, 2002, which cites "Simplified Decision Feedback Equalizer Using Interpolation" (Sanbe, et al., Technical Report of Institute of Electronics, Information and Communication Engineers (CS91-22 (1991-06) pp.37-43. Hence, the Examiner is requested to consider and initial page 2 of the

PTO-1449 Form for the IDS filed on May 6, 2002. For the Examiner's convenience, a duplicate copy of the PTO-1449 Form is resubmitted herewith.

Specification

Applicants amend the specification to correct errors.

For example, at page 18, third full paragraph, Applicants note that the term "n" in W_n differs from "n" in nT . Therefore, for clarification, the equation " $W_n = W_n + \mu \cdot E(t) \cdot R(t - nT)$ " is amended to recite " $W_i = W_i + \mu \cdot E(t) \cdot R(t - nT)$ ($i = 0, 1, 2$)". Applicants note that $W_0 - W_2$ are updated simultaneously by one symbol pattern.

Applicants submit that the ordinarily skilled artisan would recognize and understand the above correction to the specification, and submits that such amendments do not add new matter to the specification.

Also, pages 19-20, bridging paragraph, Applicants amend the specification to recite a similar effect can be expected from an nT , which is not smaller than 1/8 symbol and not greater than 1/2 symbol. Applicants note that, since a delay unit operates at one sample cycle and delays plural samples, 1/8 sample, which is less than 1 sample, is impossible. Therefore, Applicants submit that the ordinarily skilled artisan would know and understand that the phrase "*1/8 sample*" properly should read "*1/8 symbol*". Thus, no new matter has been added.

VI. CONCLUSION

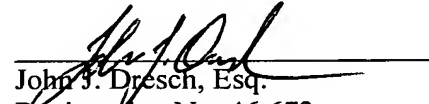
In view of the foregoing, Applicants submit that claims 1-3, 5, 7, 9 and 11-19, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,

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The Office Action objects to Figures 9A-9C and 10. Figures 9A-9C and 10 are amended herewith in accordance with the Examiner's suggestion. Therefore, the Examiner is requested to enter and consider the replacement sheets and annotated sheets showing changes made.

Attachments: Replacement Sheets (4)
Annotated Sheets Showing Changes (4)

Fig. 9A (PRIOR ART)

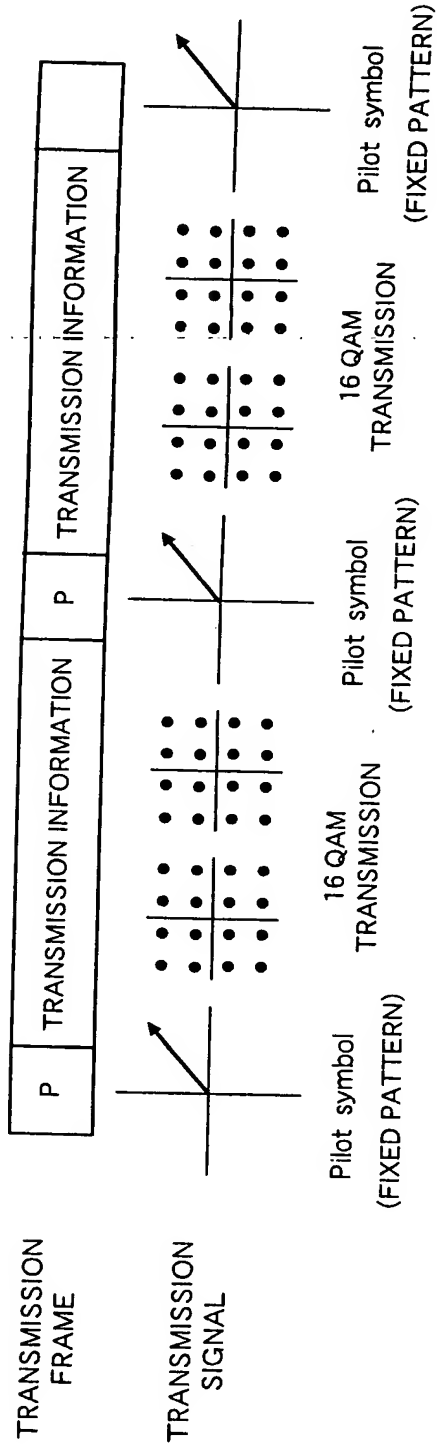


Fig. 9B (PR102-ART)

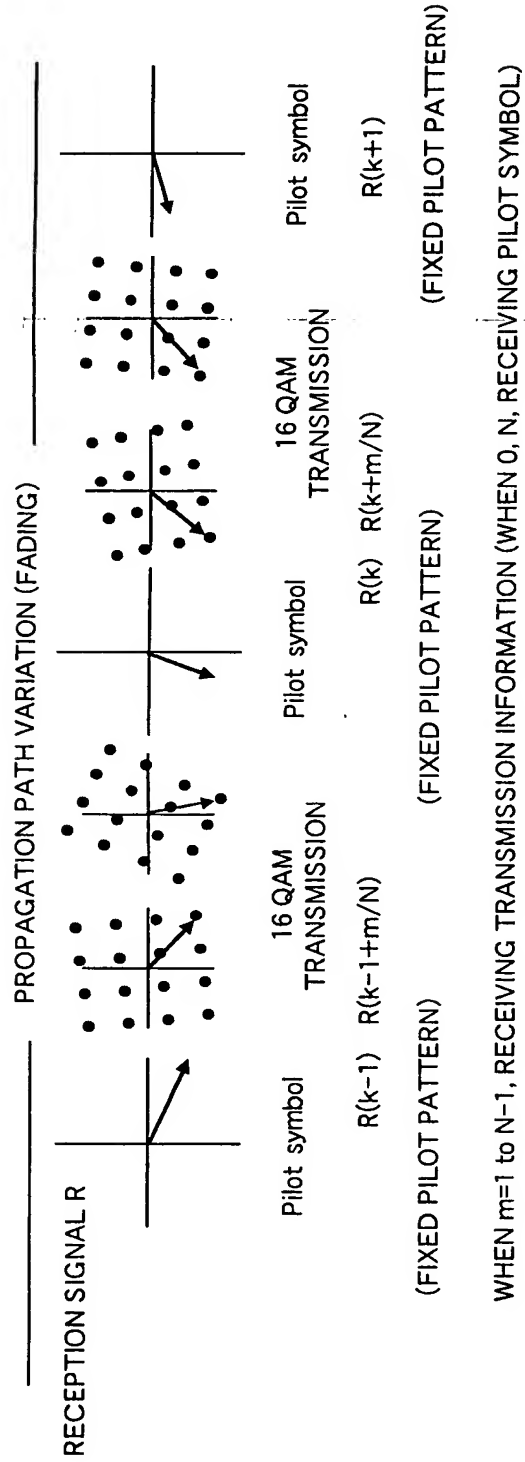


Fig. 9C (PRIOR ART)

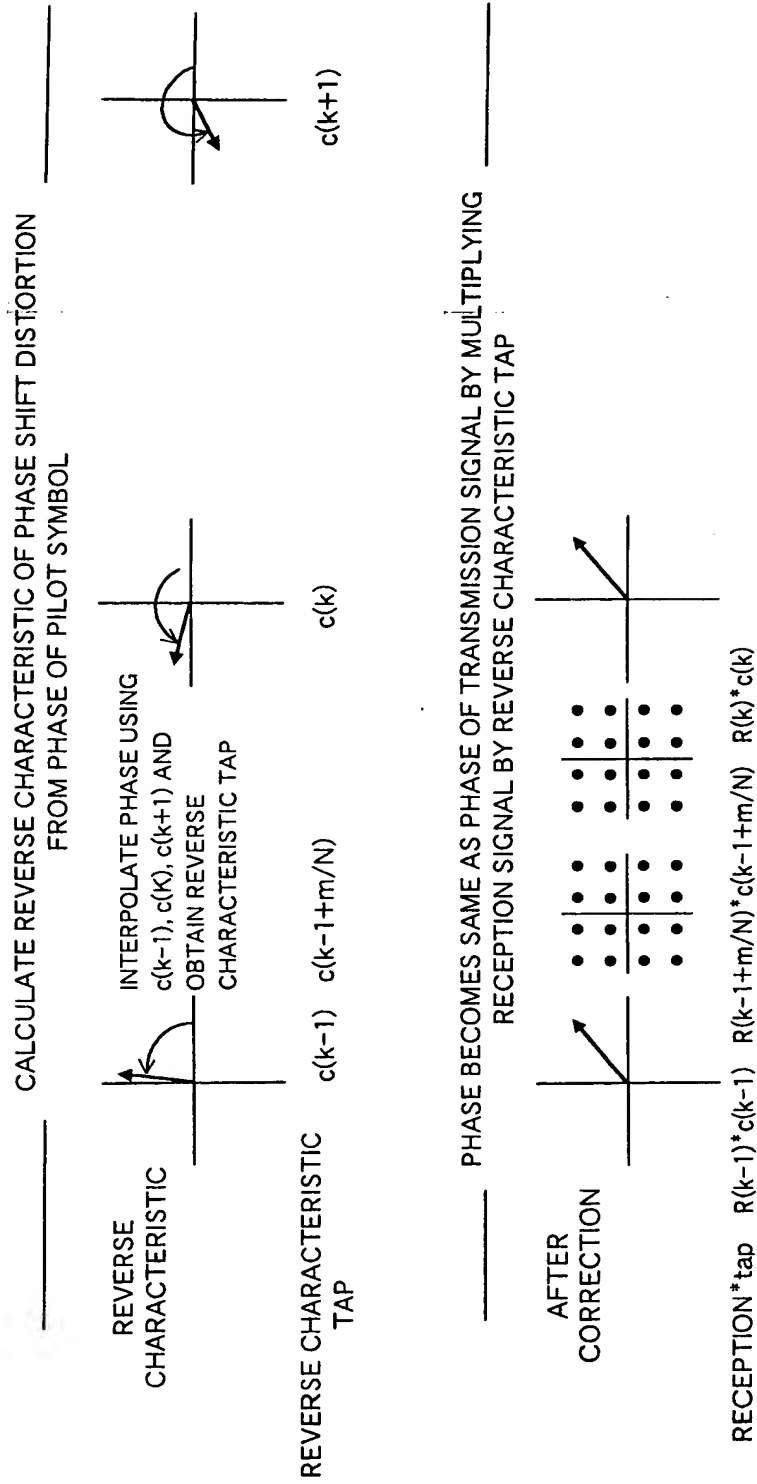


Fig. 10 (PRIOR ART)

